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CONTRIBUTIONS TO THE MORPHOLOGY OF THE LARVAL ELATERIDAE (COLEOPTERA)

NO. 1: *LUDIUS AERIPENNIS* DESTRUCTOR BROWN.

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In the realization that all exact field experimentation and census work with insects is dependent upon accurate recognition of the species involved, a study of the comparative external morphology of the larvae was planned, from the first, as an integral part of the major project on wireworms, which was inceptioned in 1922, at the Dominion Entomological Laboratory, Saskatoon, Saskatchewan. The soundness of this viewpoint has been amply demonstrated, in that the morphological work has repeatedly proved to be vital to the whole economic study of this pest, which is being increasingly recognized (King, 1928; Seamans, 1933) as one of the major problems of wheat-growing in Western Canada. For example, it has been found that the two principal economic species (*Ludius aeripennis destructor* Brown and *Cryptohypnus nocturnus bicolor* Esch.), the larvae of which, in the absence of careful structural study, undoubtedly would have been confused in the field, have sufficiently different ecological relations and reactions to weather and soil conditions as to very materially affect the general program of control (King, Arnason, and Glen, 1933).

For the first seven years this work was undertaken, personally, by K. M. King. During that period the larvae of the majority of the species occurring in arable land, and in the chief native habitats in the Saskatoon district, were studied and figured sufficiently to enable easy and accurate differentiation in the field, and most of the species of economic importance were reared to adults to make specific identification possible.

In 1929, the author was made responsible for the furtherance of this morphological study. Since then some attention has been given, annually, to collecting and rearing wireworms, and to figuring, in considerable detail, the larval characters of those species which have been brought to maturity. Definite attempts have been made to secure larvae from the various parts of Saskatchewan, and from other provinces, and increased attention has been given to the study of non-economic forms.

Some morphological details are still incompletely studied, but the structures which are regarded as of primary diagnostic value, in the species concerned, have been carefully examined and it is believed that the descriptions and figures now at hand should be published, without further delay, to make this information more widely available. To this end, a series of short papers is being prepared, each as a separate contribution to the general subject 'morphology of larval Elateridae', but differentiated by a series number and a subtitle. The earlier papers will deal with species found in Saskatchewan, but it is planned to continue the series with descriptions of wireworms occurring elsewhere.

Chief among those to whom the author wishes to express his gratitude, for assistance in the work to date, is Mr. Kenneth M. King, Dominion Entomologist for Saskatchewan. Apart from initiating the study and contributing valuable results, he has maintained an active personal interest in the progress of the work and has given directional aid throughout. My sincere thanks are also expressed to Dr. L. G. Saunders, Professor of Zoology and Entomology, University of Saskatchewan, for valuable criticisms and suggestions, and for supervision of much of the earlier work; and to Dr. C. E. Mickel, Division of Entomology, University of Minnesota, for his manifest interest in the study and his critical examination of manuscripts; also to Mr. W. J. Brown, Division of Systematic Entomology, Entomological Branch, Dominion Department of Agriculture, Ottawa, for the identification of reared adults, and for helpful notes on various taxonomic aspects of the Elateridae. Finally, grateful thanks are due the various members of the staff at the Saskatoon laboratory for the splendid co-operation they have given in the collecting and rearing of material.

It has been found, in the larval Elateridae, that a given structural character is not of equal diagnostic value in the different taxonomic subdivisions of the family. For example, a character which is of value for interspecific differentiation in one genus may characterize all the known species in another genus. Furthermore, the great majority of species are likely to be recognized by certain combinations of characters, rather than by any single character. However, as far as the work has gone, here and elsewhere (as evidenced by the literature), there are a number of structures that have continued to hold special taxonomic significance. Because of their practical importance, it is believed advisable to list them here, defining the more uncommon terms:

(1) *Nasale* (*n*, Figs. 6, 7): Henriksen's term for the thickened sclerotized process, of one or more denticles, on the anterior margin of the cephalic plate in the region between the mandibles and directly over the mouth, the "clypeus" of earlier authors; (2) other mouth parts, particularly the *mentum* and *mandibles*; (3) presence or absence of *eyes*; (4) *stout setae on the episterna* of the meso- and metathorax (*es*, Fig. 11, Fig. 17); (5) *impressions* on tergites (*ti*, *li*, Fig. 15): angular furrows or sculpture other than punctures; (6) *punctuation*, particularly on tergites; (7) *setae*, number and arrangement, especially on tergites (Fig. 15); (8) *paratergites*, *pleurites*, and *sternites* (Figs. 11, 13, 14); (9) *caudal segment* (Figs. 16, 18, 19): the 9th and 10th abdominal segments taken together (authors); important aspects are (a) the general shape, (b) number of excrescences on the side-edges of the 9th dorsum, (c) the caudal notch, (d) urogomphi—"meaning a tail-projection" (Boving and Craighead, 1931, p. 3); (10) *special structures*, such as the sclerotized hooks on the anal pseudopod of various species; and the "eye spots" on the caudal segment of certain *Agriotes* larvae.

The terminology employed has been selected from that in common use. No new terms are proposed. It is pertinent to state, however, that in naming the lateral sclerites of the thorax and abdomen an attempt has been made to follow the suggestions of Snodgrass (1931, pp. 10-11), who points out the common error made by students of insect larvae in naming as "pleurites" those sclerites which lie above the line of the dorso-pleural fold, and are, therefore, "paratergites."

Since the pleuro-ventral line (Snodgrass, 1933, pp. 3-4) could not be determined with certainty, at present, the pleurites and sternites are considered in the most general and non-committal terms available. Snodgrass is also followed in naming certain structures in the gular region. The term "cephalic plate" (Roberts, 1921, p. 202) is retained for the compound structure on the dorsal surface of the head, since it is probably a fusion of frons, clypeus and labrum. The principal sclerite of the labium is labelled "mentum", as by Boving and Craighead (1931, plate 85, Fig. J), although it is more commonly referred to by wireworm morphologists as the "submentum." In agreement with Henriksen (1911) and Ford (1917), the antennae are here considered as three-segmented, rather than two-segmented as suggested by Roberts (1921, p. 198). The source of the more important remaining terminology is stated in footnotes.

***Ludius aeripennis destructor* Brown.**

This first paper deals with subspecies *destructor* Brown, the only form of the species present in the Canadian prairies, where it is known as the *prairie grain wireworm*. The name *destructor* has been applied but recently (Brown, 1935) to this variety. In several earlier papers it has been referred to as *L. aeripennis tinctus* Lec. As far as the writer is aware no structural details of this wireworm have been published previously, the only known figure being a generalized illustration of the larva (Strickland, 1926). Only the mature larva is described¹ here.

Mature larva (Fig. 1).—Length 17-22 mm.; greatest breadth 2.75-3.25 mm. Body slightly compressed dorso-ventrally with conspicuous membranous areas on lateral aspects; tapering somewhat towards extremities, head and caudal segment two-thirds to three-quarters maximum body width. Segments slightly constricted at junctions; dorsum more convex than venter. Body surface shiny, nearly smooth; dorsum brownish-yellow (between ochraceous buff and clay colour, as in Ridgway's color standards), venter paler, head somewhat darker.

Head (Figs. 2, 6, 9) subquadrate, broader than long, wider behind than in front, noticeably flattened above and beneath. Several long, brown setae on all surfaces with additional shorter ones on dorsal and ventral aspects.

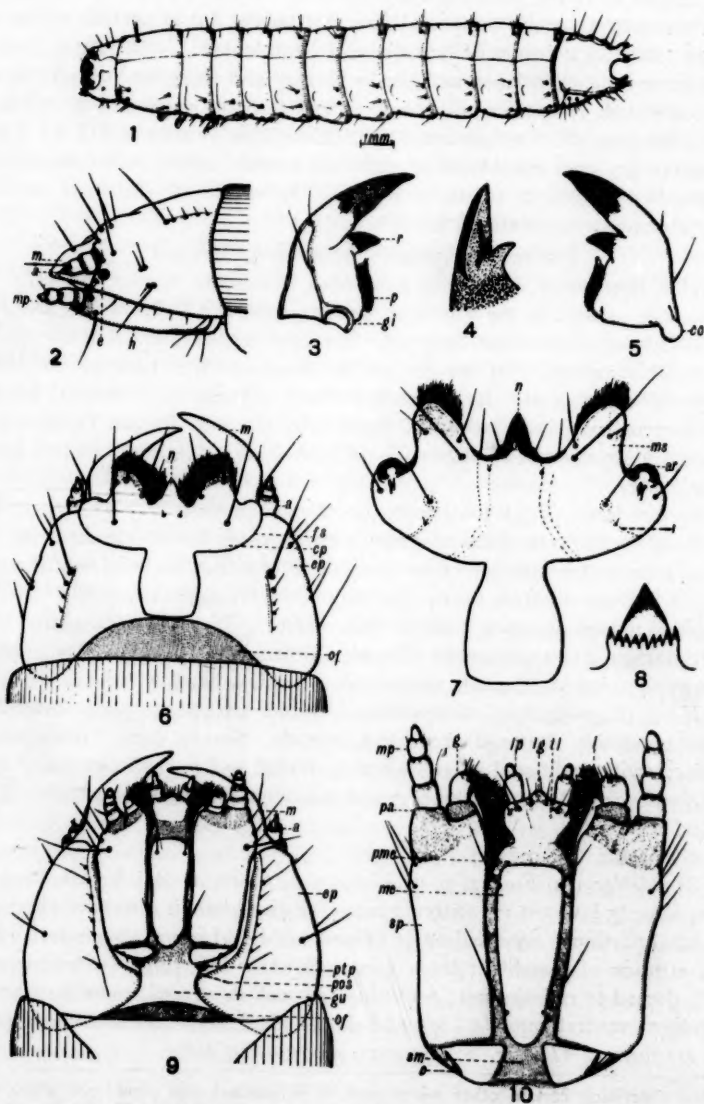
Antennae (a) short; three-segmented, with one sensory papilla on apex of second segment.

Eye spots (e) present.

Mandibles (m, Figs. 2, 6, 9; Figs. 3, 4, 5) stout, dark brown, distal half bending sharply inwards (in extreme cases the distal half is almost at right angles to the basal portion); *retinaculum* (r) about middle of inner margin, arising near ventral surface of mandible; inner face with tooth-like ridge (often completely eroded) dorsad to retinaculum; *penicillus* (p) well-developed, sometimes reaching retinaculum; ventral *condyle* (co) and dorsal *ginglymus* (gi) well-developed.

Hypostome (h, Fig. 2; Fig. 10) subquadrate, large.

¹In describing certain other wireworms, it is planned that structures which are of the same general type as in *L. aeripennis destructor* will not be fully illustrated or described except by reference to this paper. Consequently, *destructor* is presented with somewhat greater detail than most of the species treated in subsequent papers of the series. A definite attempt has been made, however, to curtail the description, especially of those parts which are regarded as typical of elaterids and, consequently, of only family significance. On the other hand, structural details which it is felt might prove to be of specific, generic, tribal, or even subfamily rank have been given due consideration.



LUDIUS AERIPENNIS DESTRUCTOR BROWN

Maxillary stipes (*sp*) as wide behind as in front, with group of five setae on lateral margin. *Lacinia* (*l*) produced slightly beyond base of second segment of galea. *Galea* (*g*) stout, two-segmented, with five or six sensory hairs on apex of second segment. *Maxillary palps* (*mp*) four-segmented. *Cardo* (*c*) of one piece (no accessory sclerites), articulating anteriorly with base of stipes and posteriorly with tentorial arm.

Mentum (*me*) large, subrectangular, with one long stout, brown seta near each corner. *Premmentum* (*pme*) and *submental area* (*sm*) membranous. *Terminal lobe* (*tl*), which Roberts (1921, p. 209) regards as comprising the fused palpigera and ligula, with two small setae on anterior margin of *ligula* (*lg*) and six hairs of moderate length in transverse row posterior to bases of palpigera. *Gular area* (*gu*, Fig. 9) not markedly constricted by *postoccipital sutures*² (*pos*) which terminate in *posterior tentorial pits* (*ptp*) at bases of cardines.

Hypopharynx subquadrate; consisting of strongly sclerotized basal bar and weaker anterior portion; anterior margin excavated in semi-circle (the side projections thus formed are termed the "horns of the hypopharynx," by Roberts, 1921, p. 206, footnote); numerous fine, yellow hairs on anterior and side margins; lateral edges of "horns" expanded medio-ventrally, densely clothed with long, yellow pubescence.

Cephalic plate (*cp*, Fig. 6; Fig. 7) with two pairs of "muscular" *impressions* (*i*); caudal portion subrectangular, terminating bluntly near *occipital foramen* (*of*). *Mandibular sclerite* (*ms*) (Henriksen, 1911) projecting further forward than tip of *nasale*.

Nasale (*n*, Figs. 6, 7) unidentate, tapering to fine median point (often dulled by erosion.)

Subnasal process (Fig. 8) of 8 or 9 short, sharp, forward-projecting teeth.

Prothorax (*T1*, Fig. 11) approximately as long as *mesothorax* (*T2*) and *metathorax* (*T3*) together. *Episterna* (*es*, Fig. 11; Fig. 17) with from 5-9 stout setae on lower margin.

Legs (Fig. 12) bearing many stout setae; number and arrangement varying widely, usually between 30 and 40 on medio-cephalic surface of *coxa* (*cx*).

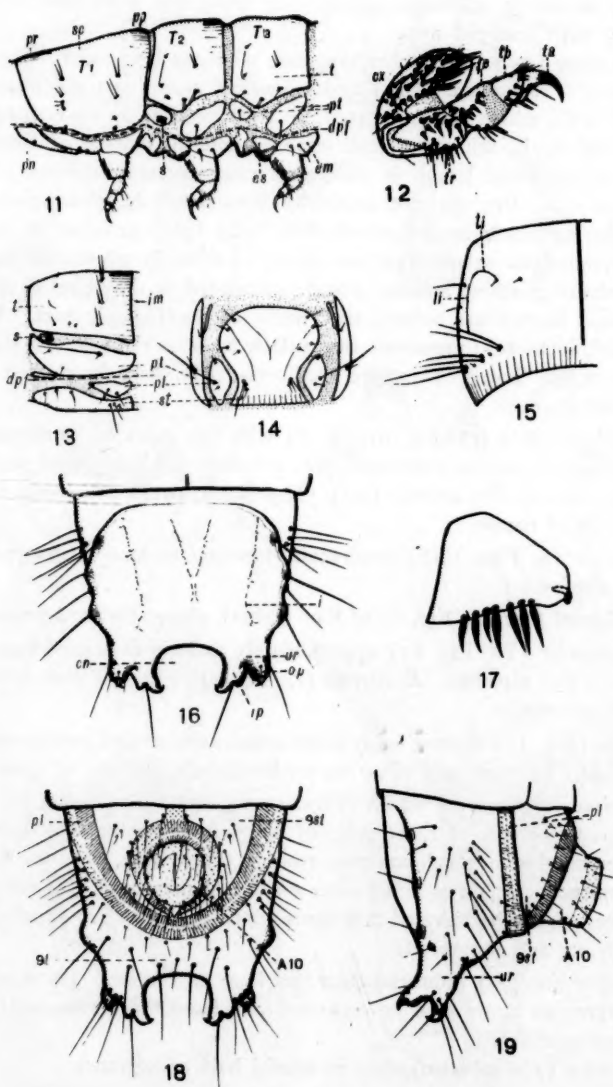
Abdominal segments 1 to 8 (Figs. 13, 14, 15) with *tergites* (*t*) each bearing: (1) posterior row of three pairs of large, brown setae, and sometimes two smaller, unpaired setae; (2) anterior row of three setae, only the most lateral being conspicuous; (3) two small setae on lateral margin; (4) small *impression* (*ti*, *li*), outer edge more elevated than inner edge. *Spiracles* (*s*) situated anteriorly between tergite and paratergite.

Paratergite (*pt*) subrectangular, as long as tergite. (A small, narrow, second paratergite appears to be separated off from the ventro-cephalic margin of the larger sclerite).

Pleurite (*pl*) subtriangular; in caudal half of segment.

Sternum (*st*) large, sides not parallel; impressions indistinct, except on specimens "cleared" with KOH.

²Terminology after Snodgrass (1928, Fig. 49) who thus labels similar sutures on scarabaeid, silphid and carabid larvae.



*Ninth abdominal segment*³ (Figs. 16, 18, 19) slightly longer than 8th; almost as long as wide, tapering caudad, posterior margin approximately three-fourths width of anterior margin; dorso-ventral dimension at anterior end approximating average width of dorsum; *caudal notch* (*cn*) wide, u-shaped; biramous *urogomphi* (*ur*), each with two strong, sharp, diverging prongs terminating in horny points; *inner prong* (*ip*) also more ventral, extending caudad in horizontal plane, turning slightly mediad making caudal notch smaller posteriorly, small knob on caudo-lateral surface; *outer prong* (*op*) projecting caudo-dorso-laterad.

Dorsum convex cephalad, flatter caudad; surface slightly rugose, free of hairs except at carinate side-edges which bear three small, setiferous tubercles, smallest being furthest cephalad; *impressions* (*i*) indistinct, sometimes observable as four shallow, irregular, longitudinal furrows.

9th tergite (*gt*) continued uninterruptedly on posterior ventral surface for one-fifth length of segment. *9th sternum* (*gst*) of two equal sclerites, each somewhat crescent-shaped with expanded anterior area. *Pleurite*⁴ (*pl*) transversely striated.

10th abdominal segment (*A10*, Figs. 18, 19) of moderate size, tubular, with two whorls of 10 short, incurving hairs; no anal armature.

The above description was drawn from the last larval exuviae of "reared" specimens, collected at Saskatoon, Sask., and from preserved whole material from the same locality, which was thoroughly checked with the exuviae to make certain that it was identical.

EXPLANATION OF PLATES. Plate 10

Fig. 1, mature larva, *Ludius aeripennis destructor* Brn.; Fig. 2, head, lateral aspect; Fig. 3, left mandible, dorsal aspect; Fig. 4, distal part of left mandible, dorso-medial aspect, showing inner surface; Fig. 5, left mandible, ventral aspect; Fig. 6, head, dorsal aspect; Fig. 7, cephalic plate, dorsal aspect; Fig. 8, subnasal process, ventral aspect; Fig. 9, head, ventral aspect; Fig. 10, hypostome, ventral aspect (all greatly enlarged).

Plate 11

Fig. 11, thoracic segments, lateral aspect; Fig. 12, left mesothoracic leg, medio-cephalic aspect; Fig. 13, 5th abdominal segment, lateral aspect; Fig. 14, 5th abdominal segment, ventral aspect; Fig. 15, left half of 5th abdominal tergum, dorsal aspect; Fig. 16, 9th abdominal segment, dorsal aspect; Fig. 17, left metathoracic episternum, lateral aspect, showing stout setae on lower margin; Fig. 18, 9th and 10th abdominal segments, ventral view; Fig. 19, 9th and 10th abdominal segments, lateral view (all greatly enlarged).

a, antenna; *ar*, point of articulation of mandible; *A10*, tenth abdominal segment; *c*, cardo; *cn*, caudal notch; *co*, condyle; *cp*, cephalic plate; *cx*, coxa; *dpf*, line of the dorso-pleural fold; *e*, eye; *em*, epimeron; *ep*, epicranium; *es*, episternum; *fe*, femur; *fs*, frontal suture; *g*, galea; *gi*, ginglymus; *gu*, gula; *h*, hypostome; *i*, impression; *im*, intersegmental membrane; *ip*, inner prong; *l*, lacinia; *li*, lateral impression; *lg*, ligula; *lp*, labial palpus; *m*, mandible; *me*, mentum; *mp*, maxillary palpus; *ms*, mandibular sclerite; *n*, nasale; *of*, occipital foramen; *op*, outer prong; *p*, penicillus; *pa*, palpifer; *pl*, pleurite; *pme*, permentum; *pn*, presternum; *po*, postscutum; *pos*, post occipital suture; *pr*, prescutum; *pt*, paratergite; *ptp*, posterior tentorial pit; *r*, retinaculum; *s*, spiracle; *sc*, scutum; *sm*, submental area; *sp*, stipes; *st*, sternum; *t*, tergite; *ta*, tarsus; *tb*, tibia; *ti*, transverse impression; *T1*, *T2*, *T3*, pro-, meso-, and metathorax, respectively; *tr*, trochanter; *ur*, urogomphus.

³In referring to the length and width of this segment the urogomphi are excluded, the posterior limit of the segment, for simplicity and convenience, being taken as of the cephalic margin of the caudal notch.

⁴In illustrating *Agriotes obscurus* L., Horst (1922, p. 8) labels this structure as the *epimeron*. Roberts (1921, pp. 201-202) in describing the same species states, " * * * the 9th sternite * * * is separated from the tergite by a deep and brownish suture. Within the suture is a belt of strong yellow chitin, marked transversely with striae similar to those forming the border to the other segments." The homology of this structure appears to be very much in doubt, but since it lies between the tergum and the sternum of the same segment it is here provisionally regarded as the *pleurite*.

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THE GENUS *TABANUS* IN UTAH¹BY J. A. ROWE AND G. F. KNOWLTON,²

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Horse flies of the genus *Tabanus* are among the most persistent and annoying of the blood-sucking pests affecting Utah livestock. In many areas of this state they are particularly troublesome to cattle and horses during much of the summer and fall. The intermittent feeding habits of the Tabanidae at once mark them as potential vectors of disease. This study has been undertaken as a part of the investigation of the role of blood-sucking insects in the transmission of equine encephalomyelitis.

¹Contribution from the Department of Entomology, Utah Agricultural Experiment Station. Authorized for publication by Director, May 23, 1935.

²Co-authorship: Graduate Research Assistant and Associate Entomologist, respectively.

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Genus *Tabanus*, Linne.

Linne, *Fauna Suecica*, 2d edition, p. 462, 1761.

Posterior tibiae without apical spurs; basal portion of the third antennal segment with a more or less dorsal prominence; wings without dark pictures (as in the genus *Chrysops*), but sometimes infuscated along the costal region and the cross-veins.

KEY TO SPECIES.

1. Eyes naked 2
 Eyes pubescent (pronounced in the males) 7
2. Large species. Abdomen entirely black 3
 Small species. Abdomen bi-colored, not entirely black 5
3. Notum of thorax with abundant white pile. Wings with a dark spot at the furcation of the third vein (Figure 8) *punctifer*
 Notum black or brown, without a spot at the furcation of the third vein 4
4. Wings sub-hyaline, abdomen with a row of small white pilose spots on the meson. 17-19 mm. (Figure 1) *aegrotus*
 Wings almost black. Abdomen with no white pile on meson. 20-22 mm. *atratus*
5. Abdomen with a uniform white stripe from the scutellum to the end of the abdomen. Anterior branch of third vein with no stump vein (Figure 5) *lineola*
 Abdomen without such a white stripe. Anterior branch of third vein with a distinct stump vein 6
6. Abdomen with three irregular gray stripes composed of contiguous spots. Fore tibia conspicuously bi-colored black and white. Stump vein usually very long (Figure 7) *productus*
 Abdomen gray, with four black or brown spots on each segment (Figure 2). Antennae red, annulate portion of third segment black *cribellum*
7. Palpi clear black *sequax*
 Palpi dirty yellow or white 8
8. Eyes with a single transverse brown band. Ocelligerous tubercle absent.. 9
 Eyes without brown band. Ocelligerous tubercle usually present..... 10
9. Ground color of abdomen largely black. Annulate portion of third antennal segment black. 11-13 mm. (Figure 9) *insuetus*
 Ground color of abdomen largely yellow. Annulate portion of third antennal segment yellow. 9 mm. (Figure 10) *utahensis* n. sp.
10. Abdomen broadly red on the sides. Pollinosity of abdomen usually not distinctly patterned 11
 Abdomen black, or if red is present, it is confined to the venter or a small spot on the side. Pollinosity of abdomen usually in the form of three rows of gray spots 12

11. Pollinosity of front golden. Pile of thorax and abdomen golden. Palpi dirty yellow. Pollen of notum thin, pile denser and striped.....*sonomensis*
 Pollinosity of front white. Pile of thorax and abdomen white. Palpi white. Pollen of notum denser gray, pile thin.....*phaenops*
12. Subcallus denuded. (Figure 6.) Abdomen with three rows of indistinct gray pollinose spots.....*rhombicus* group 13
 Subcallus not denuded. Gray pollinose spots of abdomen prominent.... 14
13. Abdomen entirely black. No stump vein on the anterior branch of third vein.....*osburni*
 Abdomen with a reddish spot on the side of the second tergite. No stump vein on the anterior branch of third vein.....*rhombicus*
 Abdomen with the first four sternites reddish, remainder black. Anterior branch of third vein with a distinct stump vein.....*centron*
14. Front with two brown pollinose spots. Abdomen with a prominent median row of gray triangles, and on either side a row of oblique spots of the same color (Figure 3).....*gilanus*
 Front entirely gray pollinose. Abdomen with a very weak or obscure median row of gray spots and on either side a prominent row of oblique gray spots (Figure 4).....*hirtulus*



1—*T. aegrotus* O. S. 2—*T. cribellum* O. S. 3—*T. gilanus* Tns. 4—*T. hirtulus* Big. 5—*T. lineola* Fabr. 6—*T. rhombicus* group. 7—*T. productus* Hine. 8—*T. punctifer* O. S. 9—*T. insuetus* O. S. Furcation of third vein, head. 10—*T. utahensis* n. sp. Furcation of third vein, antenna.

Tabanus aegrotus O. S.

O. S. West. Dipt. Bull, U. S. Geol. Geog. Surv. Ter. 3: 219, 1877.
 Williston, Tran. Kan. Acad. Sci. 10: 139, 1886.
 Hine, Ohio Nat. 5: 234, 1904.

Characteristics.—Large black species, 17-19 mm. Wings sub-hyaline. Abdomens of all our specimens show a median row of small white pilose spots on

the posterior margin of the segments (Figure 1).

Habitat.—Logan, Maple Canyon, Utah, Franklin, Wallace, Idaho.

Tabanus atratus Fabricius

Fabricius, Syst. Ent. 789, 1775.

Fabricius, Ent. Syst. 4: 336, 1798.

Fabricius, Syst. Antl. 96, 1805.

Hine, Ohio Nat. 5: 234, 1904.

Philip, Univ. Minn. Agr. Sta. Tech. Bul. 80: 103, 1931.

Characteristics.—Entirely black or brown; large species 20-22 mm; wings nearly black.

Habitat.—This species has not as yet been taken in this state. The specimens studied were labeled "Coeur d'Alene Forest, Idaho."

Hine (1904) declared *T. niger* Palisot de Beauv., *T. americanus* Drury, and *T. validus* Weid., synonyms of this species.

Tabanus centron Marten.

Marten, Can. Ent. 14: 211, 1882.

Hine, Ohio Nat. 5: 235, 1904.

Philip, Can. Ent. 67: 94, 1935.

Characteristics.—Eyes pilose; subcallus denuded; antennae black or red at the base of the third; abdomen black above, reddish on the first four sternites, remaining sternites black; anterior branch of third vein with a distinct stump vein; the extent of the red color on the center of the abdomen separates this species from *T. rhombicus* O. S. and *T. osburni* Hine.

Habitat.—Logan, Sheep Creek (Duchesne Co.), Utah.

Hine (1904) considered this species as the second form of the species *T. rhombicus* O. S., as described by Osten Sacken in his Western Diptera p. 218.

Philip (1935) placed *T. centron* Mart. as a synonym of the typical *rhombicus* and believed that Osten Sacken's second form of *rhombicus* referred to *T. hirtulus* Big. It is possible that our specimens of *centron* may be a variety of *hirtulus* with a denuded subcallus (as described by Philip, 1935). Until we are able to enlarge our series of *hirtulus* to include these varieties, we would separate these species as here treated.

Tabanus cribellum O. S.

O. S. Biol. Cent. Amer. 1: 52, 1887.

Hine, Ohio, Nat. 5: 236, 1904.

Characteristics.—Eyes naked; general color gray, about 11 mm.; long; antennae red, the annulate portion of the third black and about as long as the basal portion; abdomen gray, each segment with four brown spots (Figure 2).

Habitat.—St. George.

Hine (1904) declared *T. guttatulus* Tns. a synonym.

Tabanus gilanus Townsend.

Townsend, Psyche 8: 92, 1897.

Hine, Ohio Nat. 5: 238, 1904.

Characteristics.—Eyes pubescent, general color grayish; subcallus not denuded; notum of thorax with four dark vittae closely approximated; front with two brown pollinose spots; abdomen with a median row of gray subtriangular spots and on either side of this row, a row of oblique spots of the same color; dark and light spots of abdomen greatly contrasted (Figure 3).

Habitat.—Dry Canyon (Logan), Rock Canyon (Provo), St. George, Ft. Duchesne, Ogden, Utah; Notus, Idaho.

Tabanus hirtulus Bigot.

Bigot, Mem. Soc. Zool. Fr. 5: 641, 1892.

Hine, Ohio Nat. 5: 245, 1904 (among the unrecognized species).

Philip, Can. Ent. 67: 93, 1935.

Characteristics.—Eyes pubescent, sub-callus not denuded, anterior branch of third vein with a distinct stump; thorax with four indistinct, sometimes nearly obscure black vittae, abdomen black with a lateral row of angulate gray pollinose spots on each side, and with faint, sometimes obscure, median row of gray pollinose spots; pollinose spots of abdomen accompanied by white pile (Figure 4).

Habitat.—Richfield, Wellsville, Circleville, Flaming Gorge (Green River) Utah; Lorenzo, Idaho.

Hine (1904) failed to recognize this species as distinct from *T. sonomensis* O. S., but from material at hand we are able to separate the two species.

Tabanus insuetus O. S.

O. S., West. Dipt. U. S. Geol. Geog. Surv. Ter. 3: 219, 1877.

Coquillett, Proc. Wash. Acad. Sc. 2: 407, 1900.

Williston, Trans. Kan. Acad. Sci. 10: 138, 1886.

Hine, Ohio, Nat. 5: 238, 1904.

Characteristics.—The light brownish-yellow, pubescent eyes with a single narrow brown horizontal stripe will separate this species (Figure 9).

Habitat.—Corinne, Grantsville, Richfield, Wanship, Timpie, Uintah Mts., Indianola, Riverdale, Utah; Lone Tree, Wyo.; Tower City, N. D.

Tabanus utahensis n. sp.

Female.—Length 9 mm.; eyes yellow, pubescent, with an oblique narrow brown stripe; front and face white pollinose except on the frontal callus, and an equally large spot above the callus which are polished brown; lower part of genae with white pile; palpi narrow, nearly as long as proboscis, white with few black hairs; first segment of antennae yellow, second brown, third entirely yellowish (Figure 10); thorax black in ground color uniformly covered with white pollen, white pilose on the upper pleura; legs pale yellow except the apices of the fore tibiae and all the tarsi, which are dark; venter of abdomen entirely yellow in ground color, thinly white pollinose; dorsum of abdomen yellow in ground color, except the last four tergites which are darker, thinly white pollinose; wings hyaline, veins pale yellow, no stump on the anterior branch of third long vein (Figure 10).

Male.—None taken.

Holotype.—Dolomite, Utah, August 11, 1933 (G. F. Knowlton). In the collection of the U. S. Nat. Museum.

This species was taken from the semi-arid environment about 50 miles west of Salt Lake City. It is closely related to *T. insuetus* O. S., but its much smaller size, entirely yellowish third antennal segment, predominantly yellow abdomen and the pale wings without a stump on the anterior branch of the third vein distinguish it from any specimen of *T. insuetus* we have seen.

Tabanus lineola Fabr.

Fabricius, Ent. Syst. 4: 369, 1798.

Fabricius, Syst. Antl. 102, 1805, North America.

Aldrich, Cat. of Dipt. 204, 1905.

Hine, Ohio Nat. 5: 240, 248, 1904.

Characteristics.—The naked eyes, and the prominent white median line extending the entire length of the abdomen makes this species easily recognized

(Figure 5).

Habitat.—Ft. Duchesne, Logan, Deweyville, Trout Creek (Deep Creek Mts.), Plain City, Utah, Tower City, N. D.

Synonyms of this species seem to be (Hine, 1904, Aldrich, 1905).

T. scutellaris Walk., *T. simulans* Walk., *T. trilineatus* (Latr?) Bellardi, *T. compactus* Walk.

Tabanus osburni Hine.

Hine, Ohio Nat. 5: 241, 1904.

Characteristics.—Body polished black; eyes pubescent; subcallus denuded; abdomen entirely black; veins of the wings with bordering narrow infuscations, especially on the cross-veined and the furcation of the third vein; this species is very close to *T. rhombicus* O. S. and probably is a synonym, but we separate it from *rhombicus* by its absolutely black abdomen.

Habitat.—Logan, Utah, Coeur d'Alene Forest, Idaho. July, 1932.

Tabanus phaenops O. S.

O. S. West. Dept. U. S. Geol. Geog. Surv. Ter. 3: 217, 1877.

Williston, Trans. Kan. Acad. Sci. 10: 136, 1886.

Hine, Ohio Nat. 5: 241, 1904.

McDunnough, Can. Ent. 53: 139, 1921.

Characteristics.—Eyes pubescent; palpi yellowish; subcallus not denuded; abdomen broadly red on the sides; pollen of the front white; pile of thorax and abdomen white.

Habitat.—Numerous localities throughout Utah; the most abundant species in the state.

Tabanus productus Hine.

Hine, Ohio Nat. 5: 242, 1904.

Characteristics.—Eyes naked, body grayish, about 11 mm. long; abdomen with three rows of gray spots; notum of thorax with narrow indistinct gray stripes; anterior branch of third vein with a conspicuous stump (Figure 7), which in some specimens, meets the second long vein; fore tibiae conspicuously bicolored, black and white.

Habitat.—This is a common Utah species and is represented from northern, central, southern, and western localities.

Tobanus punctifer O. S.

O. S. "Prodrome" Mem. Bost. Soc. Nat. Hist. 2: 453, 1875-78.

O. S. West. Dipt. Bul. U. S. Geol. Geog. Surv. Ter. 3: 220, 1877.

Williston, Trans. Kan. Acad. Sci. 10: 139, 1886.

Hine, Ohio Nat. 5: 242, 1904.

Characteristics.—Easily recognized by black body, notum of thorax bearing thick white pile, and the black, round spot on the furcation of the third vein (Figure 8).

Habitat.—Common in northern and central cultivated districts of Utah.

Tabanus rhombicus O. S.

O. S. "Prodrome" Mem. Bost. Soc. Nat. Hist. 2: 472, 1875-78.

O. S. West. Dipt. Bul. U. S. Geol. Geog. Surv. Ter. 3: 218, 1877.

Williston, Tran. Kan. Acad. Sci. 10: 137, 1886.

Hine, Ohio Nat. 5: 242, 1904.

Philip, Univ. Minn., Agr. Exp. Sta. Tech. Bul. 80: 114, 1931.

Philip, Can. Ent. 67: 94, 1935.

Characteristics.—Eyes pubescent; subcallus denuded (*rhombicus* group Figure 6); body black; abdomen may have three rows of white pollinose spots;

this species is nearly like *T. centron* and *T. osburni*, except that the red on the abdomen is confined to a definite spot on the side of the second tergite.

Habitat.—Aspen Grove (Timpanogos), Uintah Mts., Provo, Blacksmith Fork Canyon (Logan), Maple Canyon (Sanpete Co.) Logan, Bingham, Utah.

Hine (1904) gave *T. melanorhinus* Big. as a synonym.

Tabanus sequax Will.

Williston, Trans. Kan. Acad. Sci. 10: 137, 1886.

Hine, Ohio Nat. 5: 243, 1904.

Characteristics.—Eyes pubescent; palpi black; costal cell hyaline.

Habitat.—Wallace, Idaho; not yet taken in Utah.

T. leucophorus Big. a synonym, Hine, 1904.

Tabanus sonemensis O. S.

O. S. West. Dipt. Bul. U. S. Geol. Geog. Surv. Ter. 3: 216, 1877.

Williston, Tran. Kan. Acad. Sci. 10: 136, 1886.

Hine, Ohio Nat. 5: 244, 1904.

McDunnough, Can. Ent. 53: 139, 1921.

Characteristics.—Eyes pubescent; abdomen broadly red on the sides; subcallus not denuded; pollen of front golden; pile of thorax and abdomen golden; palpi dirty yellow. This species is easily confused with *T. phaenops* but in well preserved specimens the two can be separated by characters given.

Habitat.—Uintah Mts., Logan, Woods Cross, Layton, Timpie, Locomotive Springs, Richfield, Benson, Bear River Bay, Skull Valley, Dolomite, Utah Public Shooting Grounds (Boxelder County).

Hine (1904) considered *T. haemaphorus* Marten a synonym of *sonemensis*, but McDunnough (1921) treated the two as distinct species.

NOTES AND NEW SPECIES OF MICROLEPIDOPTERA FROM WASHINGTON STATE

BY J. F. G. CLARKE,

Department of Zoology, State College of Washington.

Pyrallidae

PHYCITINAE.

Dioryctria xanthenobares Dyar.

On June 17, 1934, three or four green cones of *Pinus ponderosa* Dougl. were collected which showed some insect damage.

Upon examination, almost mature larvae of this *Dioryctria* were observed to have eaten away practically the entire inner portion of the cone, leaving the axis and the outer portion attached at the top and bottom so as to form a rather large retreat.

Of the two moths obtained, one emerged June 26 and the other June 29, 1934.

The larvae were collected at Rock Lake.

Ambesa mirabella Dyar.

Bred in series from larvae collected at Kamiack Butte, Whitman County, on April 26 and May 4, 1934. The larvae were feeding on *Prunus emarginata* (Dougl.) Walp.

Mr. Heinrich has informed me that these specimens are much darker than any in the National Collection and further states that the species differs somewhat in each of several localities where it has been collected.

Nephopteryx rhyodella Hulst.

A good series of this species was obtained from larvae collected April 23 and 26, 1934, at Kamiack Butte, Whitman County. The larvae were feeding on *Antennaria luzuloides* T. & G.

The moths emerged from May 19 to June 2, 1934.

The larva is as follows: Cylindrical, tapering evenly from about thorax caudally. Length 18-20 mm. Head light yellowish brown, variously marked with dark brown to black; epicranial sutures grayish; ocelli very light brown. Prothoracic shield yellow brown with a fine gray median line and variously mottled with dark brown to black, especially on the margins. Thoracic and abdominal segments of the same color as the head and shield but somewhat lighter. The ventral part of the segments heavily suffused with grayish to fuscous, particularly the thoracic segments. Dorsally there is a narrow fuscous line and laterally a double supraspiracular line of the same color; just laterad of the dorsal stripe is a broken pinkish line. On the anterior dorso-lateral surface of each segment there is a line of small oval black metallic spots extending from a point just below the dorsal line slightly caudally, then turning cephalad in the lower of the two supraspiracular lines. Posterior to this line and between the two supraspiracular lines is a horizontal arrangement of four or five similar spots. Ventral to this are two more indistinct but similar horizontal lines following the folds in the skin. These lines are absent on the prothorax and indistinct on the mesothorax and ninth abdominal segment. Anal shield of the ground color of segments and mottled with pink and brown; also spotted with small metallic dots. Spiracles edged with black. Tubercles black. Setae yellow brown. Thoracic legs yellowish inwardly and black externally. The yellow color extends to the outside as a narrow annulation. In some specimens the ground color of the segments is a light gray-green.

Pterophoridae*Platyptilia maea* Barnes and Lindsey

This species (Cont. Lepid. N. Amer., 4: 337, 1921) is very common in the vicinity of Pullman. Because of its extreme abundance it is surprising that the food plant has not been discovered before.

On February 13, 1934, while collecting larvae of *Endothenia hebesana* Walker from the seed heads of *Castilleja lutescens* Greenman, a stalk was pulled from the plant, revealing the presence of frass at the point of fracture. An examination of the crown and upper part of the root disclosed a larva which was subsequently found to be a *Pterophorid*. On the 19th of February two or three more roots were brought in, bringing the total number of larvae to seven.

From this series of larvae five moths were obtained. It appears that the larva remains in the roots during the winter. When mature it leaves the roots and pupates on some object outside. One larva collected February 13 left the roots on March 1, attached itself to one side of the breeding cage, head downward, and pupated March 2. The moth emerged March 16. Of the others one pupated February 25 and the other February 27. Both moths emerged March 9. These two were kept under identical conditions, as were the following two, but the temperatures of the latter were slightly below those at which the other two were kept. One pupated February 28 and the other March 7, and the moths

emerged March 11 and March 20 respectively. The larva which pupated on March 7 left the plant four days before pupation occurred.

The larva is as follows: Length 11-13 mm., cylindrical. Head small, round, very light yellowish; ocelli and mouth parts dark brown. Thoracic and abdominal segments dull biscay green. Prothoracic shield mainly indicated by a somewhat lighter color. There is a longitudinal dorsal rose colored stripe beginning on the posterior half of the metathorax and continuing to the last abdominal segment where it shades into the brown anal shield. The latter is prolonged into a sharp pointed process which is heavily clothed with hairs. Anterior to the posterior half of the metathorax the dorsal stripe is white and much narrower than the rose colored part. Parallel to the dorsal stripe and separated from it on either side by a lighter shade of the ground color is a white longitudinal line. There are broken but distinct supraspiracular and subspracular lines on either side. Spiracles ringed with brown. Setae white, stout; tubercles black. Secondary setae black basally, white tipped. Thoracic legs pale yellowish with a faint brown spot on the distal end of the second segment exteriorly.

Cosmopterygidae

Mompha conturbatella Hubner

Several years ago Mr. Busck determined this European species for me from material collected in British Columbia¹ by Mr. L. E. Marmont and Mr. J. G. Colville. This was the first American record of the species.

In April, 1934, I collected larvae of this species on fireweed at Kamiack Butte, Whitman County. Only one moth was obtained, this emerging May 16, 1934.

The Washington record is not surprising except that, even though it has appeared here in the southeastern part of the State, it has as yet not been recorded on the western side of the Cascades, where its food plant is much more abundant and where the locality is much closer to the habitat in British Columbia.

Gelechiidae

Isophrictis similiella Chambers.

Bred in series from larvae collected at Wilma and Almota, Whitman County, on February 23, 1934, and February 8, 1934, respectively. The larvae were boring in the stalks and smaller branches and occasionally in the dead seed heads of *Helianthus annuus* L. On November 9 of last year (1934) larvae of this species were found by a companion of mine, Mr. Roy D. Shenefelt, feeding in the stalks of *Solidago* and in the bases of the stalks (at the crown) of a species of *Artemisia* (*vulgaris*?).

The larvae are as follows: Length 6-9 mm., cylindrical, largest at metathorax. Head small, light yellowish brown to dark brown. Thoracic shield yellowish to light brown. Ground color of segments sordid whitish to yellowish. There are five longitudinal buff to reddish lines in the dorsal half; the supraspiracular lines are broken and really a series of large circular spots. Anal shield yellowish. Spiracles edged with brown. Hairs brown, Thoracic legs translucent yellowish.

The larval stage continued over winter and well on through the spring

¹Clarke, J. F. G. Report Prov. Mus. B. C. for 1930: 14, 1931.

and summer. The moths began to emerge May 17, and the last one was obtained August 9, 1934.

Evippe prunifoliella Chambers.

Mr. Busck has been kind enough to give me the name of this species and to compare my specimens with eastern specimens from which, he states, they do not differ.

This species was bred in good series from larvae collected on *Prunus emarginata* (Dougl.) Walp. at Kamiack Butte, Whitman County, May 10, 1934. The moths emerged from May 29 to June 8, 1934. One moth was reared in 1933, emerging on July 2.

Gnorimoschema chenopodiella Busck.

A short series bred from *Sarcobatus vermiculatus* (Hook.) Torr. The larvae were collected April 4, 1934, and the moths emerged from April 24 to 29, 1934. All were collected at Dry Falls, Grand Coulee.

Gelechia monella Busck.

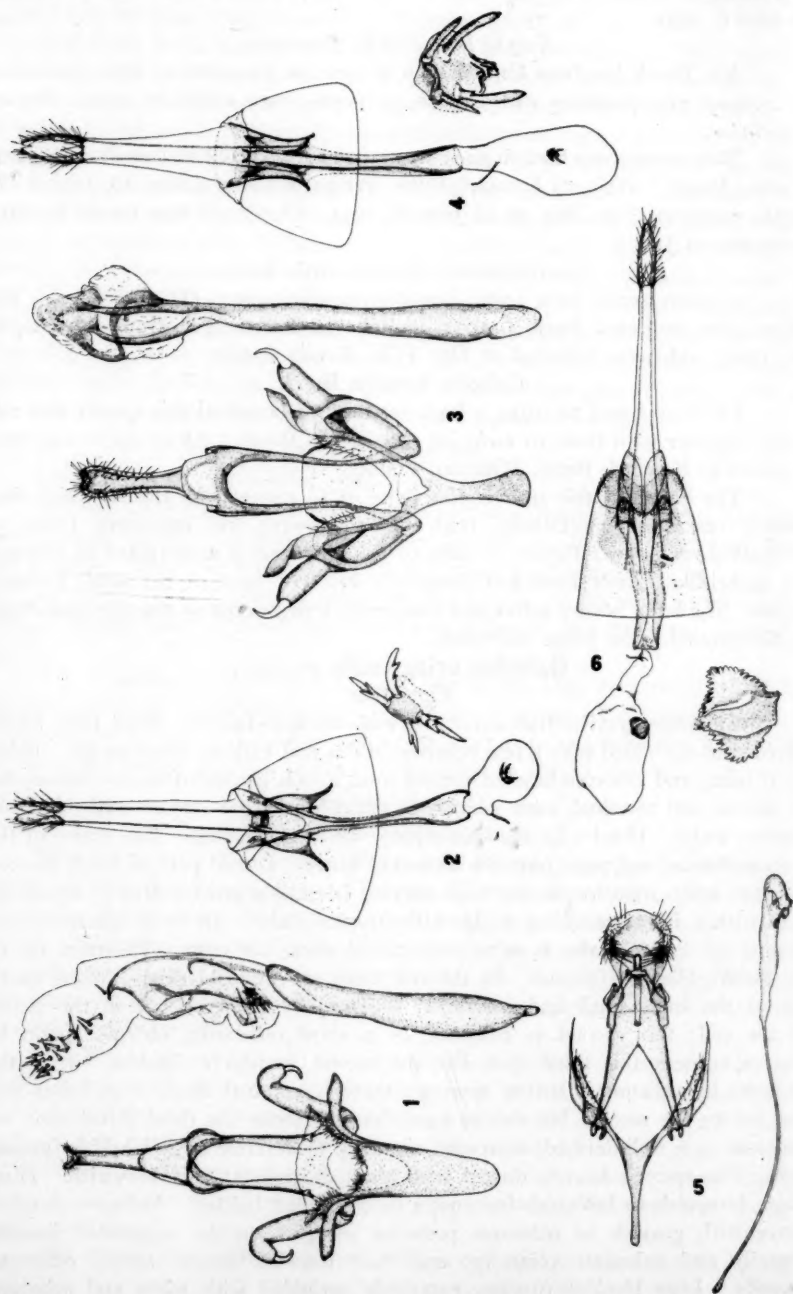
On May 5 and 10, 1934, a large quantity of larvae of this species was collected together with those of *Gelechia ceanothiella* Busck. All of the larvae were collected at Kamiack Butte, Whitman County.

The larvae of this species, like those of *G. ceanothiella* Busck, which they closely resemble superficially, feed in the flowers and immature fruits of *Ceanothus sanguineus* Pursh. A tube of silk and frass is constructed up through the umbel-like flower head and frequently involves some of the small terminal leaves. The larva is very active and frequently wriggles out of the tube and drops to the ground upon being disturbed.

Gelechia eriogonella sp. nov.

Figs. 1, 2.

Antennae grayish-drab annulated with blackish-fuscos; basal joint blackish-fuscos sprinkled with a few ocherous scales and with an ocherous tip. Palpi, basal joint, and extreme base of second joint a rich blackish-fuscos; remainder of second and terminal joint whitish to grayish-ocherous dusted with blackish-fuscos scales. Head with the face creamy white to ocherous. The scales of the face, antennae, and palpi have an iridescent lustre. Dorsal part of head, thorax, and fore wings concolorous, the color varying from light grayish-drab to brownish-drab with a light sprinkling of blackish-fuscos scales. In some specimens the dusting of darker scales is more pronounced along the costa. Posterior tip of the thorax blackish-fuscos. In the cell there are three blackish-fuscos spots, one at the base, small and indistinct, followed by a larger one in the center of the cell; this second is followed by a third outwardly oblique spot. In some specimens this third spot, like the second, is nearly obsolete, but in the majority it is distinct. In one specimen there is a fourth discal spot below and just before the second, but this is exceptional. Above the third discal spot, on the costa, is a well-defined, somewhat rounded, moderately large blackish-fuscos spot. The apex is heavily dusted with blackish-fuscos; cilia brownish. Hind wings brownish to brownish-fuscos; cilia somewhat lighter. Abdomen fuscous above with grayish or ocherous posterior margins on the segments; fuscous laterally and ocherous ventrally; anal tuft blackish-fuscos above, ocherous laterally. Legs blackish-fuscos, exteriorly sprinkled with white and ocherous



scales, inwardly shining whitish or ocherous; tarsi blackish-fuscon narrowly annulated with ocherous.

Male genitalia. Harpes divided into two arms, a short, somewhat flattened ventral one and a long, cylindrical, curved dorsal one bearing a sharp-pointed terminal process. Anellus two short separate chitinous arms fused with the harpes and joined by a membrane; lateral lobes moderately clothed with hairs. Vinculum with a long, broad, flattened anterior process. Gnathos two short lateral flaps of the integument not united. Uncus long, slender, slightly dilated distally where it is also moderately clothed with fine hairs; apex sharply pointed. Aedoeagus long, stout, and hooded distally; emitting from the hood is the membranous penis bearing from 27 to 30 (in those observed) stout spines distally and a group of six long spines proximally. Eighth abdominal segment modified to form a cover for the genitalia when at rest.

Female genitalia. Ostium plate heavily chitinized, broadly rectangular, slightly convex laterally, and ending in lateral spurs. Ductus bursae chitinized practically its entire length. The bursa copulatrix oval, proportionately small, with a small evagination at its junction with the ductus bursae which is the point of inception of the ductus seminalis. Signum large, four pointed, the stout points having a tendency to branch.

Alar expanse: 19-24 mm.

Type: U. S. National Museum No. 50943.

Type localities: Pullman and Rock Lake, Whitman County, Washington.

Food Plants: *Eriogonum heracleoides* Nutt., *Eriogonum compositum* Dougl.

Described from the male type, 12 ♂♂ and 8 ♀♀ paratypes. Paratypes distributed in the U. S. National, Canadian National, H. H. Keifer's and the author's collections.

***Gelechia rigidae* sp. nov.**

Figs. 3, 4.

Antennae black; underside of basal joint heavily suffused with ocherous. Palpi with the basal joint black; second joint white with the exterior portion of the tip, the base, and a sprinkling of scales through the brush, black; terminal joint black with the extreme base white and the tip white to ocherous; in some specimens the black terminal joint is strongly irrorated with white. Face shining white to ocherous. Thorax light brownish-buff; patagia and posterior tip of thorax jet black. The ground color of the fore wing is black, but the intensity of the color is greatly attenuated by the whitish or grayish bases of the scales, which produce, on close examination, a salt and pepper effect. At the base of the cell is a large jet black spot preceded by an oblique cream to ocherous-buff bar beginning at the costa and proceeding outwardly well into the dorsal third; in some specimens this bar forms almost a complete circle of scales around the black spot and terminates near costa. The first black spot is followed by a smaller oval one of the same color at the end of the cell; above this on the costa is a poorly defined small spot of ocherous or buff scales; following this is a whitish-ocherous spot on the costa near apical fourth and another of the same color near the tornus; in some specimens these two form almost a complete narrow fascia across the wing; the apical fourth of the wing is jet black with sometimes

a sprinkling of light scales along the termen. On the dorsal margin near the base is a small patch of ocherous to brownish scales; cilia blackish fuscous. Hind wings smoky fuscous; cilia brownish-fuscous.

Abdomen yellowish above, blackish-fuscous below, lightly sprinkled with white or ocherous scales. In some specimens the dark color of the ventral side extends around to the dorsal portion, completely obliterating the yellowish dorsal color. In such cases the postero-dorsal margins of the dark segments are narrowly edged with yellowish white. Legs with the femora white to ocherous, heavily overlaid with fuscous or black scales; tibia black or fuscous exteriorly with narrow bands of white or ocherous; inwardly the tibiae are of this latter color; tarsi black or fuscous narrowly annulated with ocherous white.

Male genitalia. Harpes divided; dorsal arm more or less cylindrical, terminating in a sharp point; ventral arm narrow, flap-like, with a slight twist in the terminal portion. Vinculum with an elongate, spatulate anterior process. Anellus two narrow chitinous arms fused at the base with the harpes; lateral lobes lightly clothed with fine hairs. Gnathos two minute short flaps not united (no more than slight outgrowths from the ventral edge of the tegumen). Uncus long, spatulate, slightly curved ventrad; the tip pointed with the lateral margins clothed with fine hairs. Aedoeagus long, slender, with hood-like chitinous distal end supporting a membranous bulbous penis; at the extreme end are a few short spines. Eighth abdominal segment modified to form a cover for the genitalia when at rest.

Female genitalia. Ostium plate nearly rectangular, slightly concave laterally. Ostium concave, small. Practically the entire length of the ductus bursae chitinized. Inception of the ductus seminalis at the posterior edge of the oval bursa copulatrix. Signum four pointed.

Both male and female genitalia are of the same type as those of the foregoing species (*erigonella*) and are very similar but are amply differentiated in details. Only a small group of North American species has this type of genitalia; all these species have veins 6 and 7 of hind wings well separated at base.

Alar expanse: 12-15 mm.

Type: U. S. National Museum No. 50945.

Type locality: Rock Lake, Whitman County, Washington.

Food plant: *Artemisia rigida* (Nutt.) Gray.

Described from the male type, four ♂♂ and eight ♀♀ paratypes. Paratypes in the U. S. National, Canadian National, H. H. Keifer's, and author's collections.

The larva is as follows: Length 9-12 mm., cylindrical and very gradually tapering posteriorly. Head and thoracic shield dark brown to black, the former with lighter colored mouth parts and the latter dorsally bisected by a fine whitish median line. The prothorax is heavily suffused with purplish-brown and has two dark brown spots laterally, the upper large, oval, and the lower small, round. All of the remaining segments are sordid whitish. Anal shield concolorous or slightly yellowish. Prothoracic legs black; mesothoracic legs of the same color but somewhat diluted; metathoracic legs white or yellowish with the last distal joint black or dark brown. Spiracles edged with brown. Setae brown.

The larvae of this species were collected on June 7, 1934, and the moths emerged from June 24 to July 12, 1934.

The larva ties several leaves together, feeds in and about these, all the while constructing a small woolly retreat. Pupation occurs in this woolly mass, which is quite conspicuous and readily reveals the hiding place of the larva or the presence of the pupa.

The larva of this species are very numerous in the vicinity of Rock Lake, but I have never found the adults under natural conditions.

***Gelechia luteogeminata* sp. nov.**

Figs. 5, 6.

Antennae black, faintly annulated with grayish; tip of basal joint ochereous. Palpi, second joint ochereous inwardly; brush with a large quantity of white-tipped fuscus scales; white exteriorly, heavily irrorated with black scales. Terminal joint black; extreme tip white or ochereous. Face whitish ochereous. Head, thorax, and ground color of fore wings blackish-fuscous (in one specimen the blackish-fuscous is almost entirely replaced by dark mouse gray). Posterior tip of thorax generally yellowish, but this character is by no means constant. Overlying all of the ground color are numerous buffy-brown scales; on the wings these form poorly defined longitudinal streaks and spots. In some immaculate specimens there is a total absence of these lighter colored scales. Just below the costa, from the base of the fore wing to about the basal third, is a jet black longitudinal streak, well defined in most specimens but on occasion consisting of two separated small black streaks. About the middle of the cell is a small yellowish spot bordered on the outer edge by a few black scales; following this at the end of the cell is a similar small spot. Before and slightly below the first is a similar but poorly-defined spot which in some specimens is entirely absent. On the costa at the apical fourth there is a patch of ochereous to buffy-brown scales (ill defined in some specimens). In some specimens there is a similar spot on the tornus, but this is irregularly present. From the costa around the termen to the tornus is a series of usually well-defined black spots. Cilia concolorous with the ground color. Hind wing grayish fuscous; cilia somewhat darker. Abdomen shining grayish with a sprinkling of ochereous scales beneath. Legs, femora blackish-fuscous heavily overlaid with white or ochereous; tibia ochereous inwardly, blackish-fuscous exteriorly; tarsi blackish-fuscous with ochereous annulations.

Male genitalia.—Harpes divided into a very slender, sharply pointed dorsal arm and a heavier, somewhat shorter ventral arm; the latter is sparsely clothed with hairs. Vinculum with a long narrow anterior process. Anellus membranous. Gnathos a long, strong hook; first it curves postero-dorsally and then antero-ventrally. Uncus very large, hood shaped; laterally there are six or seven long stout spines and numerous smaller ones. Aedeagus very long; proximal three-fifths very slender, slightly curved; distal two-fifths much heavier and dilated at the end. The whole is enclosed in a membranous sheath.

Female genitalia.—Ostium plate elongate; ostium a narrow longitudinal slit. Posterior two-thirds of ductus bursae heavily chitinized; anterior third membranous; constricted just before joining the chitinized part. Bursa copulatrix oval with the signum an oval, strongly chitinized cup-like plate with serrated out-

line; in the center the edges show as two raised transverse ridges.

Alar expanse: 14-18 mm.

Type: In U. S. National Museum, No. 50944.

Type localities: Wawawai and Rock Lake, Whitman County, Washington.

Food plant: *Eriogonum niveum* Dougl.

Described from the male type, four ♂♂ and five ♀♀ paratypes. Paratypes in the U. S. National, Canadian National, H. H. Keifer's, and author's collections.

Olethreutidae

EUCOSMINAE.

Eucosma mandana Kearfott.

At Almota, Whitman County, on February 8, 1934, numerous larvae of this species were collected. These were found feeding in the rhizomes and smaller roots of a species of *Solidago*. The larva completely destroys the succulent tissue of the rhizomes, eventually causing them to die. When attacking the roots, the larva confines its activities to rather extensive mines, pushing the frass behind it, or works on the outside, making shallow tortuous mines.

On February 24, 1934, larvae of this species were collected at Wima, Whitman County, on *Artemisia vulgaris* L. The larvae in this case seemed to attack only the outside of the roots. None were found on the inside, and most were found free in the soil. Larvae of several instars were found.

All were transplanted to plants in the greenhouse. The moths began emerging on April 22, and the last moth emerged May 19, 1934.

The description of the larva is as follows: Length 14-16 mm.; cylindrical, somewhat dorso-ventrally compressed; about even in thickness throughout the entire length. Head yellowish brown; the margins of the head capsule and mouth parts dark brown; ocelli only slightly darker than the ground color of the head. Thoracic shield and anal plate translucent yellowish. Thoracic and abdominal segments sordid whitish. Joints of the segments and points of insertion of the hairs of a waxy transparent appearance. Spiracles ringed with light brown. Thoracic legs light yellowish.

Eucosma rorana Kearfott.

On February 8, 1934, larvae of a variety of this species were collected together with those of *Suleima baracana* Kearfott, *S. helianthana* Riley, and other species feeding in the stalks or roots of *Helianthus annuus* L. All were collected at Almota, Whitman County.

There seems to be some correlation between the species involved and the area of the plant affected by each. Numerous larvae of the three species collected showed a definite preference for a certain portion of the plant. The larvae of *E. rorana* Kearfott var. infest the root and do not seem active much above the surface of the ground. The larvae of *S. helianthana* Riley affect an area of the stalk near the ground and sometimes invade the root just below the surface of the soil. *S. baracana* Kearfott shows a preference for the upper portion of the stalk and the smaller branches, frequently being found where the branch emerges from the stalk.

Mr. Heinrich has kindly informed me that the Washington specimens are

somewhat darker than the types from Utah and suggests that the differences are probably due to rearing conditions.

Epiblema obfuscana Dyar.

A series of nine specimens bred from *Solidago* sp.

Heinrich (U.S.N.M. Bul., 123: 148, 1923) records this from several states in the East and Midwest, but the present record appears to be the first for the Far West.

The larvae were collected at Almota, Whitman County, on February 8, 1934, and the moths emerged from March 30 to April 20, 1934. The species also occurs at Wawawai, where I found larvae this past November (1934). On the high plateau above the two localities named, in the vicinity of Pullman, I have also found larvae which resemble those of this species both in appearance and in the type of work done by them. As yet none from the latter locality have been reared.

In the notes given by Riley (Proc. Ent. Soc. Wash., 1: 33, 1888) he mentions the girdling habits of the larva and the emergence of the imago from the amputated end of the stalk. I have found here that the first instar larva first girdles the stalk near the tip, causing the terminal portion to wilt, die, and finally turn brown. The brown tip is very conspicuous in a patch of the food plant, and therefore the larvae are easily detected. After killing the tip, the larva feeds in the dead part, completely eating away the pithy portion of the stem. After so doing, it proceeds down the stalk, making numerous small holes through which frass is ejected. Eventually the larva reaches the crown, feeds there, and then bores into the upper portion of the root, where it remains as a larva over winter. When nearly mature, the larva again girdles the stalk from three or four inches to a foot above ground in such a manner that the upper portion of the stalk breaks off in any slight breeze or when any pressure is applied. (The easiest manner in which to collect larvae is to walk through a patch of dead stalks in the fall or winter and then go back and observe the stalk stubs, which are very conspicuous.) As stated by Riley, the orifice through which the moth emerges is covered with silk and frass. At the time of emergence the pupa is extruded.

Suleima helianthana Riley.

A bred series from larva feeding in the stalks of *Helianthus annuus* L. from Wilma and Almota, Whitman County. This appears to be the most northern record of its distribution, but in all probability it will be found in British Columbia and throughout the western United States.

Suleima baracana Kearfott.

Under this name in my paper (Can. Ent., 66: 179, 1934) I gave the food plant for this species as *Helianthella douglasii* T. and G. and described the larva. The larva referred to under this name in the above mentioned paper belongs to a variety of *S. daracana* Kearfott.

However, the larva of *S. baracana* Kearfott was found this past season (1934) feeding in the stalks of *Helianthus annuus* L., and a fine long series of the moth was obtained.

The larva of *S. baracana* Kearfott is as follows: Length 12-14 mm., robust. Head small, pointed, bilobed; shining light reddish brown; laterally faintly mottled with darker brown; epicranial sutures and clypeus dark brown; ocelli and a small

spot on the posterior lateral margin black. Mandibles very large, dark brown. Prothorax not much broader than head; prothoracic shield shining light reddish brown, translucent, divided in middle by a fine longitudinal yellowish brown line. Mesothorax and metathorax much larger than prothorax (the latter may be drawn into the mesothorax almost half its length) and equal in size to the abdominal segments. All segments glossy cadmium yellow. Spiracles ringed with light brown. Setae reddish brown. Anal shield small, triangular, faintly marked with brown. Thoracic legs translucent, yellowish brown.

The moths of this species began to emerge March 29, and the last was obtained June 12, 1934.

The larvae were collected at Wilma and Almota, Whitman County, and at Coulee City. The latter (one specimen) was collected April 2, 1934.

Epinotia lindana Fernald

Under this name (Can. Ent., 66: 180, 1934) I gave the distribution for the species as California, Colorado, and Utah, citing Heinrich (U.S.N.M. Bul., 123: 206, 1923). This was an error resulting from my misidentification of the species as *E. albicapitana* Kearfott, which error was subsequently corrected by Mr. Heinrich. The distribution given above is for *albicapitana*, while that for *lindana* is far more widespread, including Pennsylvania, Quebec, Ontario, Manitoba, British Columbia, and California, as well as Washington.

OLETHREUTINAE

Ahmosia galbinea Heinrich.

In the type series Heinrich (U.S.N.M. Bul., 132: 99, 1926) lists one specimen from Almota (C. V. Piper, collector).

At this same place on March 15, 1934, I found many larvae of this species feeding externally on the leaves of *Gaura parviflora* Dougl. At the same time some pupae were also taken. The larva feeds in the terminal shoots and new leaves of the plant, webbing them together or folding the leaves. The extensive webbing causes great distortion to the leaves and early shoots, but later in the season the injury is not perceptible. Pupation occurs between two leaves or in a folded one in a rather heavy cocoon.

The larva is as follows: 12-13 mm. long; cylindrical, slightly dorso-ventrally compressed; largest about the abdominals 4, 5, and 6; dull green. The mature larvae show some slight suffusion or dull reddish. (Alcohol specimens show a decided suffusion of dull fuscous.) Head small, shining black; mouth parts brown. Thoracic shield shining black, except for the anterior third which is translucent greenish and a very narrow dorso-median light greenish line. Tubercles of the prothorax large, black; remainder concolorous with segments. Setae brown. Thoracic legs black. Spiracles narrowly ringed with black. Suranal plate green with a slight yellowish tinge.

The moths began to emerge March 20, and the last one was obtained April 22, 1934. In all 115 specimens were reared.

I wish to thank both Mr. Busck and Mr. Heinrich for several of the determinations and many helpful suggestions.

EXPLANATION OF PLATE 13

Fig. 1. *Gelechia eriogonella*. Paratype male. Fig. 2. *Gelechia eriogonella*. Paratype female. Fig. 3. *Gelechia rigidae*. Paratype male. Fig. 4. *Gelechia rigidae*. Paratype female. Fig. 5. *Gelechia luteogeminata*. Paratype male. Fig. 6. *Gelechia luteogeminata*. Paratype female.

